

**SVKM's**  
**D. J. Sanghvi College of Engineering**

**Program: B.Tech in Information Technology**

**Academic Year: 2022**

**Duration: 3 hours**

**Date: 21.01.2023**

**Time: 09:00 am to 12:00 pm**

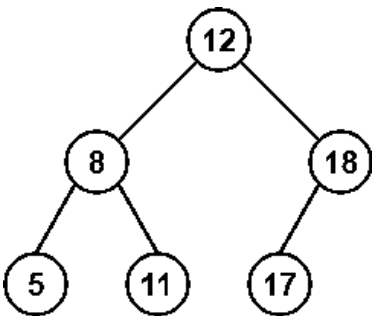
**Subject: Data Structures and Algorithms (Semester III)**

**Marks: 75**

**Instructions: Candidates should read carefully the instructions printed on the question paper and on the cover page of the Answer Book, which is provided for their use.**

- (1) This question paper contains two pages.
- (2) **All Questions are Compulsory.**
- (3) All questions carry equal marks.
- (4) **Answer to each new question is to be started on a fresh page.**
- (5) **Figures in the brackets on the right indicate full marks.**
- (6) **Assume suitable data wherever required, but justify it.**
- (7) Draw the neat labelled diagrams, wherever necessary.

Question No.		Max. Marks
Q1 (a)	Write an algorithm to merge two sorted linked lists to create a new one. Take any two sample sorted linked lists and trace your algorithm on it.  <b>OR</b> Write an algorithm to insert a node into a sorted doubly linked list. Trace your algorithm on sample sorted doubly linked list	<b>10</b>
Q1 (b)	Write an algorithm to find the length of a circular linked list	<b>05</b>
Q2 (a)	Write down an algorithm, which will take a string 'S' as input. The string S is formed using alphabets {a, b, c} only. Find whether the input string is from the set $L = \{a^n b^m c^k \mid n = m + k \text{ and } n, m, k \geq 1\}$ . E.g., aaabbc, aaaabccc $\in L$ and abbc, aabccc $\notin L$ . Use appropriate data structure and justify it. Trace your algorithm on sample input given in the example.	<b>10</b>
Q2 (b)	Consider the following three claims I. $(n + k)^m = \Theta(n^m)$ where k and m are constants II. $2^{n+1} = O(2^n)$ III. $2^{2n} = O(2^n)$ Which of these claims are correct? Justify your answer.  <b>OR</b> There are n unsorted arrays: $A_1, A_2, \dots, A_n$ . Assume that n is odd. Each of $A_1, A_2, \dots, A_n$ contains n distinct elements. There are no common elements between any two arrays. Find the worst-case time complexity of computing the median of the medians of $A_1, A_2, \dots, A_n$ ? Justify your answer.	<b>05</b>
Q3 (a)	Write down an algorithm for finding the depth of a node X in the binary search tree.	<b>05</b>

Q3 (b)	<p>Write down the algorithm to perform following operations on Double Ended Queue, which is to be implemented using circular array.  Enqueue_Rear(x), Enqueue_Front(x), Dequeue_Front(), Dequeue_Rear().</p> <p style="text-align: center;"><b>OR</b></p> <p>In the Josephus problem from antiquity, n people are in a crisis and agree to the following strategy to reduce the population. They arrange themselves in a circle (at positions numbered from 0 to n - 1) and proceed around the circle, eliminating every mth person until only one person is left. Legend has it that Josephus figured out where to sit to avoid being eliminated. Using appropriate data structure, write a program that takes two integer command-line arguments m and n, and prints the order in which people are eliminated (and thus would show Josephus where to sit in the circle).</p>	<b>10</b>
Q4 (a)	<p>Give an algorithm for checking whether a given graph G has simple path from source s to destination d. Assume that the graph G is represented using the adjacent matrix. Trace your algorithm on any graph.</p> <p style="text-align: center;"><b>OR</b></p> <p>Explain briefly: priority queue. Which is the best way to implement the priority queue? Justify your answer. State various applications of priority queue.</p>	<b>08</b>
Q4 (b)	Sort the letters of word “EXAMPLE” in alphabetical order using insertion sort.	<b>07</b>
Q5 (a)	<p>Consider AVL Tree given below</p>  <pre> graph TD     12((12)) --- 8((8))     12 --- 18((18))     8 --- 5((5))     8 --- 11((11))     18 --- 17((17)) </pre> <p>Perform following operations on it. Calculate balance factor of each node after every operation.</p> <p>I. Insert keys {14, 3, 2, 98, 76}</p> <p>II. Delete keys: {12, 8}</p> <p style="text-align: center;"><b>OR</b></p> <p>Write down an algorithm for finding the mirror of BST and trace the algorithm on AVL tree given in Q5a.</p>	<b>07</b>
Q5 (b)	<p>Consider following four hash functions on integers.  <math>h(i) = i^2 \bmod 10</math>, <math>h(i) = i^3 \bmod 10</math>, <math>h(i) = (11 * i^2) \bmod 10</math>, <math>h(i) = (12 * i) \bmod 10</math>  Which function from the above four will distribute keys most uniformly over 10 buckets numbered 0 to 9 for i ranging from 0 to 9? Justify your answer.</p>	<b>08</b>